This article deals with continuous and efficient working of a milling tandem with the help of a new “Quick Mill By-Pass System”. The author has developed this idea at Kenana Sugar Co. Ltd. and has increased Kenana’s time utilization efficiency to 95.5% and is aiming to increase it above 97%. Any one mill unit can be isolated for the purpose of repair, maintenance, inspection or mill re-setting and can be put back on line without losing recordable time, while all other mill units in the tandem continue working. Existing and proposed by-pass systems are illustrated. The new system is simple in design, easy to operate and will have low installation and maintenance costs. Any long milling tandem having individual mill drives, rake type intermediate carriers and Donnelly chute facilities will benefit by adapting the by-pass system.

INTRODUCTION

Kenana Sugar Co. Ltd., located in the Sudan, is one of the largest single undertakings in the history of sugar manufacturing. It has its own sugar-cane estate and integrated sugar refinery. The factory has a sugarcane grinding capacity of 17,000 tonnes per day and produces more than 300,000 metric tons of refined sugar in a 5 months season. The success of this project has been attributed to the modern self setting constant ratio FCB twin milling tandems, automation and interlocking systems.

There are two similar milling tandems each having two sets of cane preparation knives, one swinging hammer type FCB shredder and seven self setting constant ratio type FCB mills of 1,200 mm x 2,300 mm roller size. All the mills are driven by individual steam turbines and rake type intermediate carriers with low head Donnelly chutes. There is extensive instrumentation and interlocking implemented wherever possible throughout the factory. Kenana’s reduced mill extraction is between 96.85 and 97.14%, and recovery % cane ranges from 11.27 to 12.04%. Average fiber in cane is 17%.
The plant was erected and commissioned in 1979-80 and faced many problems to achieve the designed capacity. The major problems were breakdowns of intermediate carriers, mills and low speed gearboxes. Time utilization efficiency (TUE) was very low.

For any minor problem on mills, such as trash plates, coupler and tail bars, pinion bearings, low speed gearboxes, high speed gearboxes, steam turbines, etc., the whole milling tandem had to be stopped. The aim of this work was to achieve the highest possible time utilization efficiency (TUE), defined here as the grinding time % valuable crop time.

**DEVELOPMENT**

The need for a facility for isolating any one mill unit while keeping other mills operating was identified. This was a novel idea. Isolation of one mill unit in a seven mill tandem was unlikely to have an adverse effect on the grinding capacity but would cause a slight decrease in milling efficiency, which was judged to be acceptable.

**DETAILS OF ISOLATION FACILITY**

With reference to Figure 1, a mill unit can be isolated as follows:

For isolating mill unit M₂, by-passing plate ‘P’ and mill overflow chute ‘F’ were fabricated.

Mill overflow chute ‘F’ was designed to be supported by slots ‘S’ and fixed by nuts and bolts ‘B’ mounted by the help of a mill overhead crane. By-passing plate ‘P’ was designed and fabricated to suit the sizes of the Donnelly chute top inlet neck. The plates were made from stainless steel to avoid friction.

Special care was taken to maintain the best possible working condition of all conveyors and intermediate carriers to minimize breakdowns.

**OPERATION**

In practice the isolation of a milling unit required that the milling tandem grinding was stopped for about 30 min. During this time, overflow chute ‘F’ was mounted by hooks ‘H’ in the slots ‘S’ and bolted by nut and bolts ‘B’. The by-pass plate ‘P’ was mounted on the top of the Donnelly chute and tack welded. All other mills and equipment were then restarted.
C - Sugarcane/bagasse
M1 - Former mill unit
M2 - Latter mill unit
P - By-pass plate.
F - Mill overflow chute
S - Slots on Donnelly chute
H - Hooks on overflow chute
B - Nutbolts for fixing overflow chute

FIGURE 1. Early version of by-pass system.
Maintenance of the mill unit and associated drive could then be performed without losing valuable production time. On completion of the maintenance, the milling operations were stopped for about 30 minutes while the by-pass plate ‘P’ and overflow chute ‘F’ were taken out.

The presence of the mill overflow chute ‘P’ was found to be no obstruction to normal operations and so all mills in both the milling tandems were provided with suitable mill overflow chutes which were left to hang on each of the chutes.

It is not necessary to mount a by-pass plate if the reason for the isolation of the mill unit does not involve the Donnelly chute, rollers or trash plate. In this case the Donnelly chute is merely allowed to fill with bagasse. This practice has increased the TUE of Kenana Sugar Co.Ltd. considerably (Figure 2).

This method is not useful if the bagasse filling the Donnelly chute is going to be an obstruction. The by-pass plate ‘P’ must be used in such cases. The complete grinding operation must then be stopped for a total of one hour for fitment and removal of this by-pass plate.

**PROPOSED “QUICK MILL BY-PASS SYSTEM”**

A “Quick Mill By-Pass (QMB) System” has been designed to further increase the TUE at Kenana. Any one mill unit in both the milling tandems can be isolated within seconds using this system. It is anticipated that with this system lost production time due to maintenance and cleaning could be brought down to only 4 h every fortnight per milling tandem, instead of 10 h (present practice). The resultant TUE, could be a record in the history of the sugar industry.

**DESCRIPTION OF THE QUICK MILL BY-PASS SYSTEM**

The QMB system is depicted in Figure 3. A longer by-pass plate ‘P2’ will be located below the intermediate carrier bottom shell. This will be supported on guide rollers ‘R2’. Movement of ‘P2’ will be controlled by power cylinder ‘N2’ to isolate or take in line the mill unit ‘M2’ (Figure 3). In this case there will not be any recordable time loss. When all mill units are in operation, the by-pass plate ‘P2’ will be kept resting below the intercarrier in the retracted position.

The cylinder ‘N2’ will be operated by pneumatic or hydraulic power. A flexible hose could be used to connect the cylinder ‘N2’ through the solenoid
FIGURE 2. Historical trend in time utilization efficiency.
C - Sugarcane/Bagasse
M1 - Former mill unit
M2 - Latter mill unit
M3 - Following, next mill unit
P1 & P2 - Mill by-pass plates
R1 & R2 - Guide rollers
N1 & N2 - Power cylinders, pneumatic/hydraulic
A1 & A2 - Solenoid valves
F1 & F2 - Mill overflow chutes
K1 & K2 - Slots in the inlet neck of Donnelly chutes
J1 & J2 - Detachable middle portions of Donnelly chutes.

FIGURE 3. Proposed "Quick Mill By-Pass (QMB) System"
FACTORY ENGINEERING

valves 'A1' and 'A2'. The mill unit 'M2' could be isolated or taken on line quickly and easily without recordable time loss. The interlocking system in the milling tandem will be by-passed for mill unit 'M2' and the remaceration juice pump of the next mill 'M3' will be stopped and kept idle. Juice will be allowed to travel through the juice gutter to the juice pump of the mill unit 'M2' which will pump the juice to 'M1'. Thus, there will not be imbibition juice mixing in the bagasse between mill units 'M1' and 'M2' as long as mill unit 'M2' is in an isolated condition. All the operations of bypassing or taking in line the mill unit will be carried out within a few seconds, resulting in a theoretical TUE in excess of 97%.

ADVANTAGES OF THE NEW “QUICK MILL BY-PASS SYSTEM”

The following will be the major advantages of the new system:

There will be no significant time loss in isolating any mill unit or putting it back into operation. This will potentially result in a very high TUE of the milling tandem. TUE's of 95.52% have been achieved and levels in excess of 97% may be possible with the proposed QMB system.

Any single mill unit could be isolated with mill and Donnelly chute completely free from bagasse. Mill personnel will be able to attend to maintenance, inspection, re-setting and the like without disturbing the milling tandem's grinding operations.

Proper arcing could be carried out easily on all the roller surfaces by isolating each mill unit turn by turn. Proper arcing will maintain a very high milling efficiency. The time lost on periodic maintenance shut-downs would also be reduced.

The QMB system will be of a simple design with very low installation and maintenance costs.

The detachable portion 'J1' and 'J2' of the Donnelly chutes (Figure 3) could be easily taken out for better accessibility if the top roller needed to be lifted for trash plate problems.

CONCLUSIONS

The author has proposed a new technique of QMB system at Kefiana Sugar Co. and has increased its TUE to 95.5% and is aiming to increase it above 97%. Any one mill unit can be isolated for the purpose of repairs, maintenance,
inspection or mill-resting and can be put back in the line of operation without losing recordable time, because all other mill units in the milling tandem continue to operate without interruption.

The new QMB system is simple in design, and will have very low installation and maintenance costs. Any other long milling tandem in the sugar industry world having individual mill drive, rake type intermediate carriers and Donnelly chute facilities could potentially benefit in TUE by adapting this QMB system.

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TECHNIQUES POUR UN BROYAGE EFFICIENT

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RESUME

Ce papier décrit une nouvelle technique aux moulins, comprenant un travail continu et efficient grâce à une méthode de by-pass appelée "Quick Mill By-Pass System". L'auteur a développé cette idée à la Sucrerie de Kenana. La méthode a amélioré l'efficience de l'emploi du temps aux moulins et ce chiffre est monté jusqu'à 95.5%. On espère qu'une valeur de 97% soit possible. N'importe quel moulin du train peut être isolé pour être inspecté, repaire ou règle est peut-être retourné en service sans affecter les autres moulins. Les systèmes de by-pass actuels et le nouveau système est simple et montre un faible cout d'installation et d'entretien. Les trains de moulins avec moteurs individuels, transporteurs à raclettes et chutes Connelly peuvent bénéficier de ce système de by-pass.
Este artículo se refiere a la técnica moderna de Molidas Continuas y sin interrupciones, a través del uso de sistema de By-Pasaje Rápido de cualquier Molino, y por lo tanto aumenta la eficiencia total del tren. El autor desarrolló y aplicó esta idea en Kenana Sugar Co., Ltd., y logró aumentar la eficiencia del tiempo utilizado a un 95.5% y tiene como meta llograr por sobre el 97%. Con este sistema cualquier Molino en particular puede aislarse del resto del tren con el propósito de hacer reparaciones, mantenimiento preventivo, inspecciones, ajustes etc, y ponerse nuevamente en la línea sin pérdida de tiempo registrado. Adjunto pueden observar las ilustraciones del sistema propuesto. Este sistema además de ser simple en su diseño, presenta numerosas ventajas por su instalación práctica y bajo costo de construcción y mantenimiento. Es compatible con cualquier tipo de tren de Molinos con movimiento individuales ya sean de conductores de alimentación intermedias de talibillas, rastrillos o embudos de tipo Donnelly etc.